In the Claims

1. (Currently Amended) A method of imaging large volumes without resulting slab-boundary artifacts comprising:

defining a desired FOV larger than an optimal imaging volume of an MR scanner;

selecting a slab thickness in a first direction that is smaller than the desired FOV and within the optimal imaging volume of the MR scanner;

exciting and encoding spins to acquire data that is restricted to the selected slab thickness;

acquiring a set of MR data that includes acquiring full encoding data in the first direction for a subset of another two directions;

step-wise moving one of the optimal imaging volume and an imaging object; and

acquiring another set of the MR data between each step-wise movement until the desired FOV is imaged.

2. (Previously Presented) The method of claim 1 wherein the step of exciting and encoding spins is further defined as restricting excitation to the slab thickness such that data acquisition is restricted to the selected slab thickness.

3. (Original) The method of claim 1 wherein the step of exciting and encoding spins is further defined as restricting data acquisition by encoding and filtering data so as to acquire data that is limited to the selected slab thickness.

4. (Original) The method of claim 1 wherein the first direction is in a direction of the step-wise movement and is defined as in a z-direction and a number of image pixels obtained within the selected slab thickness in the z-direction is at least equal to a number of k_x-k_y subsets.

5. (Original) The method of claim 1 wherein MR data acquisition between step-wise movements includes acquiring all k-space data in a direction of motion of a patient table for a selected subset of k-space data in the other two directions.

6. (Original) The method of claim 1 further comprising continuing to apply the slab-selective RF pulse during table movement to maintain a steady-state.

7. (Original) The method of claim 1 wherein over-sampling of MR data in the first direction is avoided.

8. (Original) The method of claim 1 further comprising applying magnetic field gradients that encode a 3D k-space trajectory that is uniform in a k-space dimension along the step-wise movement (k_z).

9. (Original) The method of claim 8 wherein the 3D k-space trajectory has time-varying waveforms during MR data acquisition to minimize overall scan time.

10. (Original) The method of claim 8 wherein the 3D k-space trajectory is one of a 3D EPI k-space trajectory, a cylindrical-stack of EPI k-space trajectory, a stack-of-spirals k-space trajectory, a stack-of-TWIRL k-space trajectory, a stack-of-projection-reconstruction k-space trajectory, and a 3DFT k-space trajectory.

11. (Original) The method of claim 1 further comprising the step of maintaining a position of the slab thickness fixed relative to a magnet of the MR system during imaging of the desired FOV and the step-wise moving of a table.

12. (Original) The method of claim 1 further comprising selecting a distance of the step-wise movement as an integer multiple of an image resolution in the first direction.

13. (Previously Presented) The method of claim 2 further comprising applying a slab-selective RF pulse to restrict the excitation, the slab-selective RF pulse having linear phase, sharp transitions, and low in-slice ripple to reduce image artifacts from z-dependent variations in phase and amplitude.

14. (Original) The method of claim 1 further comprising selecting the step-wise movement distances to acquire complete MR data in each direction.

15. (Original) The method of claim 1 further comprising:

transforming MR data in a z-direction;

sorting and aligning the transformed MR data to match anatomic locations in the first direction to fill a z-k_x-k_y space matrix.

16. (Original) The method of claim 15 further comprising reconstructing an MR image by transforming the z-transformed MR data in x and y.

17. (Original) The method of claim 15 further comprising gridding the MR data to reconstruct an MR image.

18. (Original) An MRI apparatus to acquire multiple sets of MR data with a moving table and reconstruct MR images without slab-boundary artifacts comprising:

a magnetic resonance imaging (MRI) system having a plurality of gradient coils positioned about a bore of a magnet to impress a polarizing magnetic

field, and an RF transceiver system and an RF switch controlled by a pulse module to transmit RF signals to an RF coil assembly to acquire MR images;

a patient table movable fore and aft in the MRI system about the magnet bore; and

a computer programmed to:

receive input defining a desired FOV larger than an optimal imaging volume of the MRI system;

define a fixed slab with respect to the magnet to acquire MR data;

acquire full MR data in a direction of table motion, defined as z-direction, for a selected k_x-k_y subset in the fixed slab;

increment the patient table while maintaining position of the fixed slab; and

repeat the acquire and increment acts until an MR data set is acquired across the desired FOV to reconstruct an image of the FOV.

19. (Previously Presented) The MRI apparatus of claim 18 wherein the computer is further programmed to transmit magnetic gradient waveforms to encode a 3D k-space trajectory that is uniform in k_z and wherein a number of patient table increments with distances that are a multiple of a z-resolution are selected to ensure complete sampling of central z-k_x-k_y matrix data.

20. (Original) The MRI apparatus of claim 18 wherein the computer is further programmed to:

transform MR data with respect to z;

align the z-transformed MR data to match anatomy across slab boundaries; and

transform the z-transformed MR data with respect to x and y to reconstruct an MR image.

21. (Original) The MRI apparatus of claim 18 wherein the computer is further programmed to:

apply a slab-selective RF pulse to excite a volume of interest in the z-direction;

apply a 3D k-space trajectory to encode the volume interest; and

wherein the MR data acquired in the z-direction has a number of pixels that are at least equal to a number of k_x-k_y subsets.

22. (Original) The MRI apparatus of claim 18 wherein the computer is further programmed to:

apply an RF pulse to excite a volume of interest;

apply a 3D k-space trajectory to encode the volume of interest;

filter the acquired MR data to restrict the MR data to the defined fixed slab; and

wherein the MR data acquired in the z-direction has a number of pixels that are at least equal to a number of k_x-k_y subsets.

23. (Original) The MRI apparatus of claim 18 wherein the computer is further programmed to continue to apply an RF pulse during table movement .

24. (Original) The MRI apparatus of claim 18 wherein the computer is further programmed to select patient table increments as an integer multiple of a desired z-resolution.

25. (Original) The MRI apparatus of claim 18 wherein the computer is further programmed to increment the patient table in steps having a distance that is a multiple of a z-resolution.

26. (Original) The MRI apparatus of claim 18 wherein the computer is further programmed to:

acquire all k_x data for a selected k_x-k_y subset;

define a set of magnetic field gradient waveforms to incrementally encode and acquire k_z-k_x-k_y data in a given slab; and

apply the set of magnetic field gradient waveforms in a cyclic order.

27. (Original) The MRI apparatus of claim 25 wherein the computer is further programmed to:

transform MR data in z;

sort and align the z-transformed MR data to match anatomic locations with respect to z to fill a z-k_x-k_y space matrix; and

reconstruct an MR image by transforming the aligned MR data in x and y.

28. (Currently Amended) A computer program to control a medical image scanner and create images across scanning boundaries without boundary artifacts, the computer program having a set of instructions to control a computer to:

select an FOV spanning an area greater than a predefined optimal imaging area of the medical image scanner;

apply an RF pulse to excite a region in at least a first direction in the selected FOV;

apply magnetic field gradients to encode the region in the first direction;

acquire 3D k-space data in the first direction for a subset of a second and third direction;

reposition the predefined optimal imaging area, with respect to an imaging object, an incremental step;

repeat data acquisition and the imaging area incremental reposition until complete image data are acquired across the entire FOV to reconstruct an image of the FOV.

29. (Original) The computer program of claim 28 wherein the incremental repositioning of the imaging area includes having further instructions to move a patient table a fixed distance to acquire additional k-space data.

30. (Original) The computer program of claim 28 having further instructions to:

move a patient table a fixed distance for a number of acquisitions until a set of k-space data are acquired for 3D image reconstruction of a given slab;

move the patient table a greater distance than the fixed distance;

repeat the act of image data acquisition for a second slab; and

move the patient table the fixed distance for the same number of acquisitions as for the first slab until a set of image data are acquired for 3D image reconstruction.

31. (Previously Presented) The computer program of claim 28 wherein the 3D k-space data includes MR data, and having further instructions to:

Fourier transform MR data in z;

sort and align the z-transformed MR data to match anatomic locations in z to fill a z-k_x-k_y space matrix.

32. (Original) The computer program of claim 28 wherein the 3D k-space data is acquired in z for a subset of k_x-k_y, and wherein the 3D k-space data acquired in z has a number of pixels that is at least equal to a number of k_xk_y subsets.

33. (Original) The computer program of claim 28 having further instructions to move a patient table in incremental step distances that is a multiple of a z-resolution.

34. (Previously Presented) The computer program of claim 28 having further instructions to maintain a position of a slab thickness fixed, relative to a magnet of the medical image scanner, during the imaging of the desired FOV and while repositioning the imaging area.

35. (Original) The computer program of claim 28 wherein the RF pulse is a slab-selective RF pulse having linear phase, sharp transitions, and minimum in-slice ripple to reduce image ghosting from z-dependent variations in phase and amplitude.

36. (Previously Presented) The computer program of claim 28 wherein the first direction is a z-direction and the 3D k-space data includes MR data, and the MR data acquired in the z-direction is represented in a number of retained pixels, the number of which is greater than a number of k_x-k_y subsets, and wherein the RF pulse is continually applied to maintain a steady-state but where MR data is not acquired during table movement, and wherein the magnetic field gradients encode a 3D trajectory that is uniform in k_z.

37. (Original) The computer program of claim 28 having further instructions to:

acquire all k_z data for a selected k_x-k_y subset;

define a set of magnetic field gradient waveforms to incrementally acquire k_z-k_x-k_y data in each slab; and

apply the set of magnetic field gradient waveforms over each slab.